REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the final Office Action of July 12, 2005 is respectfully requested.

As an initial matter, several amendments have been made to the specification in order to provide antecedent basis for new language in the amended claims. However, no new matter has been added. Therefore, the Examiner is respectfully requested to enter the amendments to the specification.

In the outstanding Office Action, the Examiner rejected pending claims 1-14 in view of the prior art. In particular, the Examiner rejected independent claim 1 and several of the dependent claims as being unpatentable over the Dubin reference (US 5,972,192) in view of the Reid reference (US 6,716,334) and the Landau reference (US 6,261,433). In addition, the Examiner rejected claim 10 which depends from independent claim 1 as being unpatentable over the Dubin reference in view of the Reid reference and the Landau reference, and further in view of the Yamakawa reference (US 4,906,341). The Examiner also rejected independent claim 7 and several of the dependent claims as being unpatentable over the Reid reference in view of the Landau reference, and rejected claim 13 which depends from independent claim 7 as being unpatentable over the Reid reference in view of the Landau reference and further in view of the Yamakawa reference. However, as indicated above, independent claims 1 and 7 have now been further amended, and new dependent claim 15 has been added, so as to further clarify the distinctions between the present invention and the prior art. Therefore, for the reasons discussed below, it is respectfully submitted that pending claims 1-15 are clearly patentable over the prior art of record.

As explained on page 2, lines 16-26 of the specification, a problem arises when attempting to plate a substrate having an interconnection pattern (i.e., fine interconnection grooves) formed thereon. In particular, the interconnection pattern creates areas in which the interconnections are closely spaced (i.e., a high-density area) and areas that are essentially free of interconnections (a low-density area). During plating, a larger amount of material is deposited over the high-density area, resulting in the formation of an abnormal "hump" having a greater

plating thickness. Consequently, subsequent polishing of the plated surface will become more difficult, and there is an increased likelihood of short circuits being created between the interconnections.

The present invention as recited in amended independent claim 1 has been developed in order to avoid the above-described problems. In particular, as recited in amended independent claim 1, a substrate having a *high-density area* with closely-spaced grooves and a *low-density area* free of grooves is bought into contact with a plating solution containing an accelerator and an inhibitor. The substrate is plated with an electric current to form a plated metal film, and the electric current is stopped to interrupt the plating. Then, the plated metal film is etched electrolytically with a direct electric current opposite to the electric current during plating *so as to prevent abnormal deposition of the plated metal film on the high-density area of the substrate*. Subsequently, the substrate having the etched metal film is plated to form a remaining film thickness to reach the desired film thickness (see page 9, lines 13-20). As a result, the abnormal humps formed over the high-density area are minimized or eliminated so as to prevent difficulty during polishing of the plated substrate (see page 18, lines 1-5).

The Dubin reference discloses a method of pulse electrode plating copper or copper alloys. As the Examiner has noted, the Dubin reference teaches initially partially plating a substrate, then etching the partially-plated substrate, and then completing the plating (see column 6, lines 28-30; and column 7, lines 1-15). However, the Dubin reference does not disclose or suggest performing the plating, etching, and plating on a substrate *having a low-density area free of grooves and a high-density area with closely-spaced grooves*, which is highly-susceptible to abnormal "hump" formation as explained above. Instead, the Dubin reference merely teaches plating so as to fill a high aspect ratio opening (see column 6, lines 30-31; and column 7, lines 15-17). Thus, the Dubin reference also does not disclose or even suggest etching a plated metal film electrolytically *so as to prevent abnormal deposition of the plated metal film on a high-density area of the substrate*, and then subsequently plating the substrate having the etched metal film to form a remaining film thickness.

The Reid reference, the Landau reference, and the Yamakawa reference also do not, either alone or in combination, disclose or suggest plating a substrate having a high-density area and a low-density area, and then etching the plated metal film on the substrate so as to prevent abnormal deposition of the plated metal film on the high-density area, and finally plating the substrate having the etched metal film to form a remaining film thickness. Therefore, one of ordinary skill in the art would not be motivated to modify or combine these references so as to obtain the invention recited in amended independent claim 1. Accordingly, it is respectfully submitted that amended independent claim 1 and the claims that depend therefrom are clearly patentable over the prior art of record.

Independent claim 7 is directed to a method of plating a substrate with copper, comprising bringing a substrate into contact with a processing liquid offering surface activity of a surface of the substrate and/or increasing wettability between a plating solution and the surface of the substrate, performing removal of the processing liquid from the substrate and/or drying of the substrate, and then bringing the substrate into contact with the plating solution to plate the substrate *after* performing the removing of the processing liquid from the substrate and/or drying the substrate. Furthermore, independent claim 7 has now been amended to clarify that the bringing of the substrate into contact with the processing liquid and the bringing of the substrate into contact with the plating solution are performed, respectively, in *separated units arranged in the same horizontal plane*.

Because the substrate is brought into contact with the plating solution *after* removing the processing liquid and/or drying the substrate, the processing liquid is prevented from adversely affecting the plating process. Furthermore, because the processing liquid contact and the plating solution contact processes are formed in *separated units*, the possibility of contaminating the plating solution with the processing liquid or otherwise having the processing liquid affect the plating process is significantly minimized. Finally, because the separated units are arranged in the same horizontal plane, the substrate can easily be moved from one unit to the other to perform these processes.

The Reid reference discloses an electroplating process with pre-wetting and rinsing. The Examiner has asserted that the Reid reference teaches a pre-treatment step which is carried out before plating, and also teaches that it is undesirable for excess water to enter the plating solution, thus providing motivation for removing pre-treatment solution from the wafer. However, the Reid reference discloses that the processes are performed in a single unit, cell 100 (see column 2, lines 45-47; and column 4, lines 25-28). In particular, the processes are performed by moving a wafer holder 190 holding a wafer W between three positions 1, 2, 3 as illustrated in Figure 1 and described in column 3, lines 31-47. Thus, the Reid reference does not disclose or even suggest the processes of bringing a substrate into contact with a processing liquid and bringing the substrate into contact with a plating solution, wherein the processes are performed in *separated units arranged in the same horizontal planes*.

The Examiner has also asserted that the Landau reference provides details of performing a pre-treatment step prior to plating, including the application of a processing solution offering surface activity prior to plating. In particular, the Landau reference teaches applying ultra pure water to a substrate plating surface to ensure complete wetting of the surface (see column 18, lines 35-39). Although the location at which the ultra pure water can be introduced to the substrate plating surface is not specifically mentioned in the Landau reference, it is at least implied that the ultra pure water is introduced within cell 40 where the plating is performed. Consequently, it is submitted that the Landau reference also does not disclose or even suggest bringing a substrate into contact with a processing liquid and bringing a substrate into contact with a plating solution in *separated units arranged in the same horizontal plane*. Because the Dubin reference and the Yamakawa reference also do not disclose or even suggest this feature, one of ordinary skill in the art would not be motivated to modify or combine the prior art references of record so as to obtain the invention recited in amended independent claim 7. Accordingly, it is respectfully submitted that amended independent claim 7 and the claims that depend therefrom are clearly patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

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